Expedition: Treasures From 125 Years of Discovery

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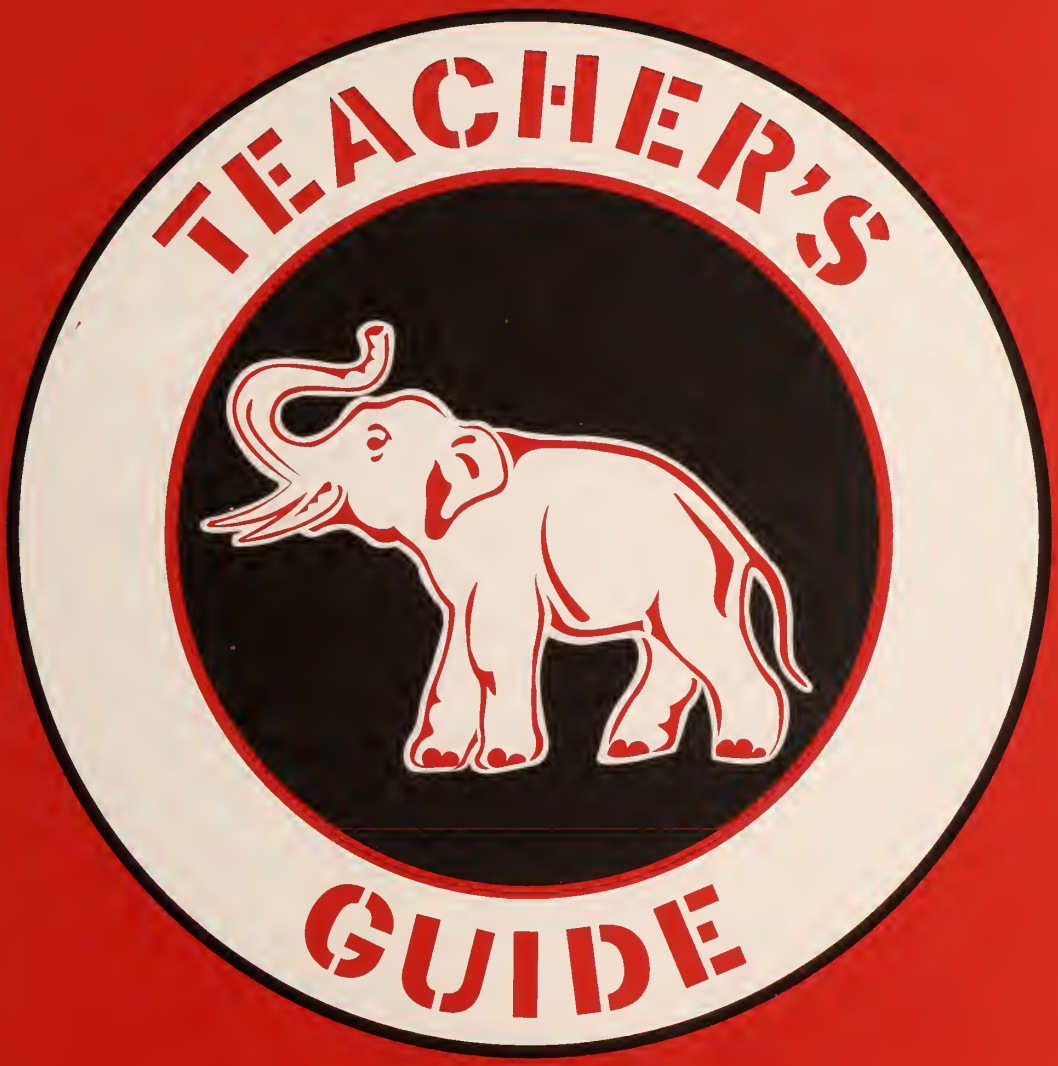

American Museum of Natural History

Ref QH70 .U52N3977 1995

Welcome

to the American Museum of Natural History and to *Expedition: Treasures from 125 Years of Discovery.* A great adventure awaits you and your students. In the halls of this Museum you will be able to transport yourselves back to the Age of Dinosaurs, explore the building blocks of life, trace paths of evolution across vast stretches of time, experience the richness and variety of human culture, and witness the incredible diversity of life on our planet.

These are just some of the things Museum personnel do every day. Research scientists constantly explore and expand the frontiers of scientific knowledge. The exhibition staff creates innovative ways to bring new information to the public. The education staff develops and implements programs and activities that engage everyone in the excitement of discovery. Every year over 100 expeditions set forth from the Museum to distant places building on the great tradition of exploration that's at the heart of this Museum and that has brought us so many of the treasures you will see on your visit.

Now, as the Museum celebrates its 125th anniversary, you and your students are invited to join in the experience: the excitement, wonder, and joy of discovery.

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The Jack and Susan Rudin Exploration Trails Program
at the American Museum of Natural History

The Teacher's Guide to the children's *Expedition Passport* has been made possible by a generous gift from Jack and Susan Rudin. We are grateful for their support of the Museum's educational mission, and for their continuing dedication to enriching the learning experiences of the children of New York City.

To the Teacher

This Teacher's Guide has been developed to accompany the American Museum of Natural History's *Expedition: Treasures from 125 Years of Discovery.* The children's expedition, which encompasses the areas of geology, paleontology, anthropology, biology, and ecology, highlights 20 treasures from the Museum's collection. The aim of the expedition and these materials is to help children enjoy and actively participate in the discovery and experience of the natural world and the cultural traditions of the people who inhabit it.

This packet of material includes the following:

- a videotape cassette
- *Expedition Passport* (Children's Guide)
- *Expedition: Treasures from 125 Years of Discovery* (Adult Guide)
- Teacher's Guide.

The Videotape Cassette

This exciting videocassette introduces students to the American Museum of Natural History and its tradition of exploration. It highlights some of the Museum's scientific departments and previews some of the fascinating exhibits students will see. *The videotape should be shown to students prior to their visit and may be used to help students set purposes for the visit. Please return the videocassette to the Junior Base Camp.*

The Expedition Passport

This children's guide highlights 20 treasures on the children's expedition tour. Photographs and detailed information about each exhibit is provided along with critical thinking questions that will help stimulate students' interest. A glossary of unfamiliar terms, a bibliography, and a floor plan of the Museum are also provided.

Note: The material is arranged to follow a tour which begins on the second floor with the Barosaurus and ends on the fourth floor with the mastodon. Please follow normal school registering procedures before starting the tour on the second floor.

Expedition: Treasures from 125 Years of Discovery

This adult guide, which highlights 50 of the Museum's treasures, is included for your convenience. It may be useful to you in planning future trips to the Museum.

Teacher's Guide

This guide provides information and activities to help you make the most of your visit to the Museum.

The guide includes:

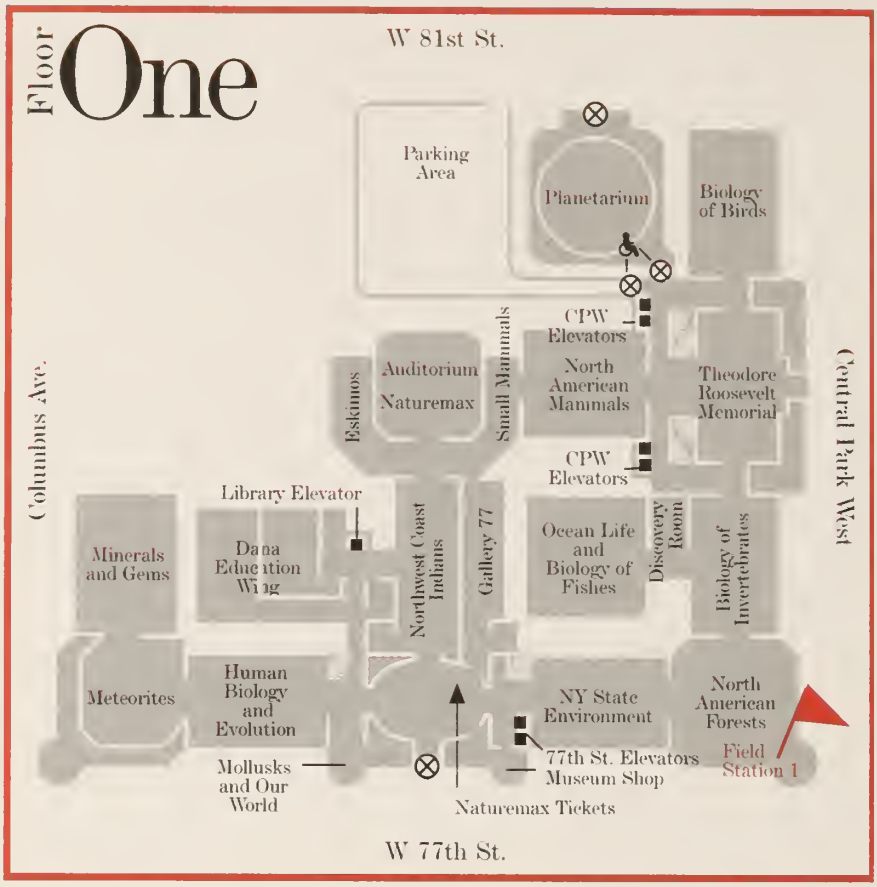
- Pre-visit Activities that familiarize students with the Museum and its collections. The activities introduce students to the skills scientists use to observe, make inferences, and draw conclusions.
- Overviews of scientific areas that provide background information about the subject area and the Museum's collection.
- Activities that will help students explore and extend their understanding of the subject area. Activities for each area of investigation–geology, paleontology, anthropology, biology, and ecology – are included. They emphasize cooperative learning and are coded according to their level of difficulty.
- A bibliography containing books of special interest to teachers.

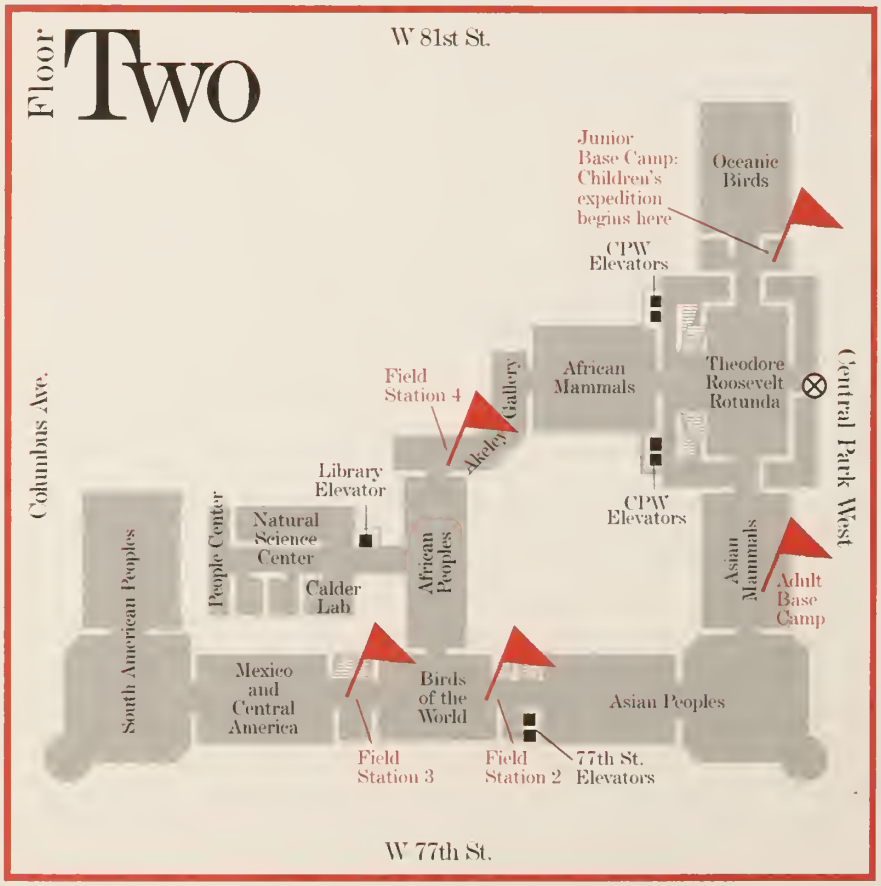
Planning Your Visit

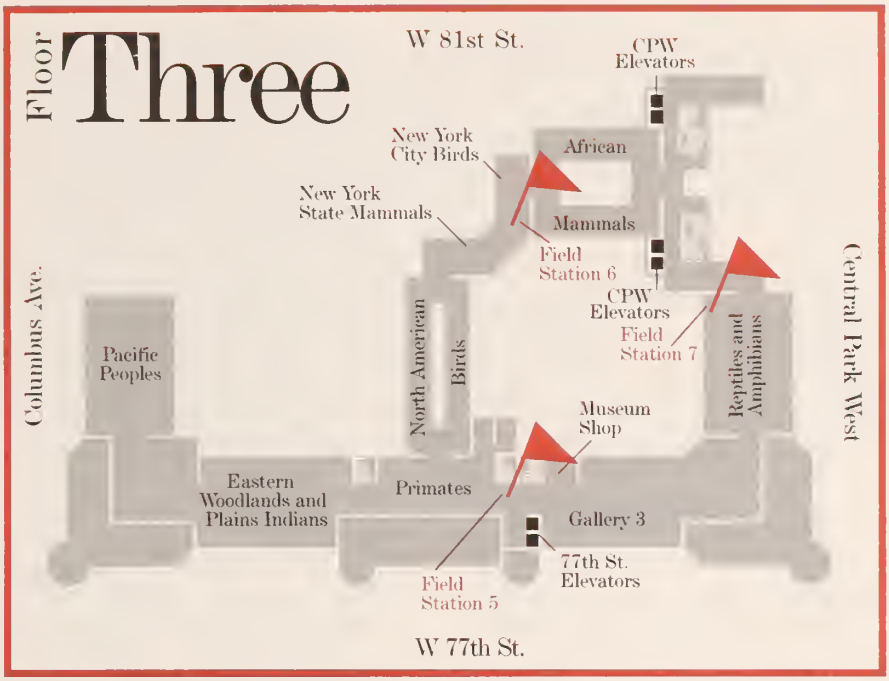
Use the *Expedition Passport* and the floor plan in this guide to plan the tour your class will take. You may choose to visit all 20 exhibits following the tour outlined in the guide or you may choose to concentrate on a specific area such as ecology or anthropology. Because of the high interest generated by *Expedition: Treasures from 125 Years of Discovery*, the Museum may be crowded. It may be useful to have a back-up plan in case the exhibits you wish to visit are crowded. For example, if the Hall of the Northwest Coast Indians is crowded you might take your class to the Mexico and Central America exhibit.

Copies of the *Expedition Passport* for each of your students will be waiting for you at the Junior Base Camp on the day of your visit. Please return the videocassette to the Junior Base Camp at this time. You will also receive free admission/family membership offers for each of your students. *It is recommended that you give students the free admission cards once they have returned to the school.* These cards provide students and their families free, one-time admission to the Museum. They also offer 30% off the family membership rate.

LIBRARY
OF THE
AMERICAN MUSEUM
OF NATURAL HISTORY


Floor One
W 81st St.
Parking Area
Planetarium
Biology of Birds
CPW Elevators
Auditorium
Naturemax
Eskimos
Small Mammals
North American Mammals
Theodore Roosevelt Memorial
Columbus Ave.
Central Park West
CPW Elevators
Library Elevator
Minerals and Gems
Dana Education Wing
Northwest Coast Indians
Gallery 77
Ocean Life and Biology of Fishes
Discovery Room
Biology of Invertebrates
Meteorites
Human Biology and Evolution
NY State Environment
North American Forests
Field Station 1
77th St. Elevators
Museum Shop
Mollusks and Our World
Naturemax Tickets
W 77th St.


Floor Two
W 81st St.
Junior Base Camp: Children's expedition begins here
Oceanic Birds
CPW Elevators
African Mammals
Theodore Roosevelt Rotunda
Field Station 4
Gallery
Akeley
Columbus Ave.
Central Park West
Library Elevator
CPW Elevators
Natural Science Center
People Center
Calder Lab
African Peoples
Asian Mammals
Adult Base Camp
South American Peoples
Mexico and Central America
Birds of the World
Asian Peoples
Field Station 3
Field Station 2
77th St. Elevators
W 77th St.


Floor Three
W 81st St.
CPW Elevators
New York City Birds
African
New York State Mammals
Mammals
Field Station 6
CPW Elevators
Field Station 7
Columbus Ave.
Central Park West
Pacific Peoples
North American
Birds
Reptiles and Amphibians
Museum Shop
Eastern Woodlands and Plains Indians
Primates
Gallery 3
77th St. Elevators
Field Station 5
W 77th St.

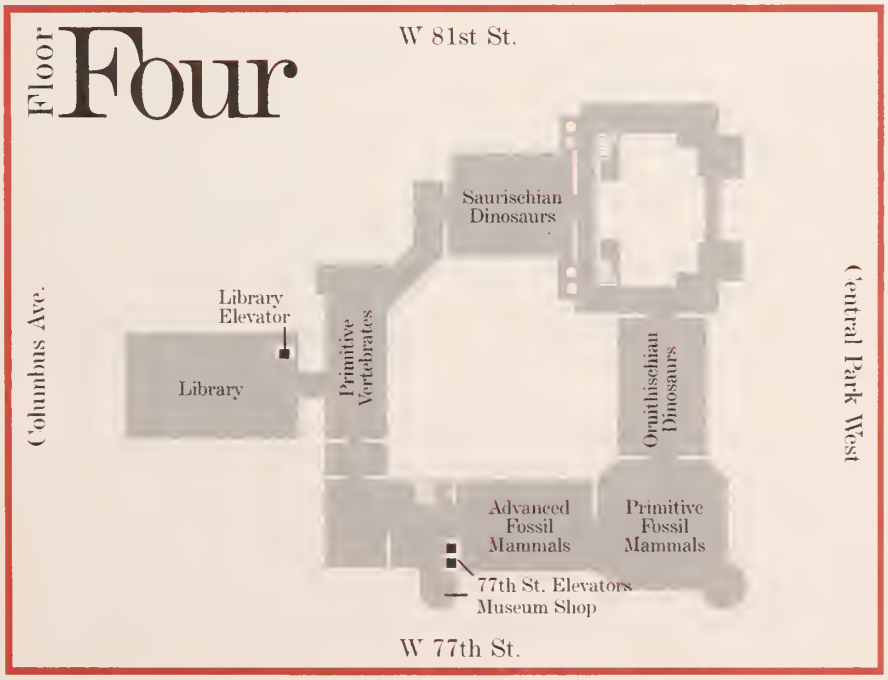

Floor Four
W 81st St.
Saurischian Dinosaurs
Library Elevator
Library
Primitive Vertebrates
Ornithischian Dinosaurs
Columbus Ave.
Central Park West
Advanced Fossil Mammals
Primitive Fossil Mammals
77th St. Elevators
Museum Shop
W 77th St.

Photo: AMNH

The American Museum of Natural History is devoted to collecting, studying, and exhibiting materials and information about the Earth's animal life and human history and the history and make up of the Earth itself. Specialists in various aspects of this great range of subjects work in the Museum's scientific departments, conducting research projects that may take them to almost any part of the world, from a tropical forest to an Arctic island or to the Museum's new molecular biology laboratory. Recent work in this laboratory by the Entomology Department has isolated DNA from fossil insects millions of years old.

In expeditions to the Gobi Desert, scientists from the Vertebrate Paleontology Department have discovered a fossil embryo inside one of the dinosaur eggs unearthed there. Embryos of an unusual fish, the coelacanth, were found by Ichthyology Department scientists dissecting a specimen. Even in our well–explored world, scientists in departments from Mammalogy to Ornithology and Herpetology continue to identify new species of mammals, birds, reptiles, and amphibians. The Invertebrate Department studies some of the earliest of the Earth's life forms, while the Anthropology Department focuses on the development and ways of life of the late comers — humans. Mineral Science specialists devote their work to subjects ranging from volcanoes to gems and meteorites, while the Hayden Planetarium takes off into outer space, dealing with topics relating to astronomy. Many of your students, and maybe even you yourself, may wonder how and why the animals in the many exhibits look so real and lifelike. The Akeley Method of taxidermy is a technique perfected by Carl Akeley, the man who conceived and planned many habitat groups in this Museum. A taxidermist, naturalist, and sculptor, Akeley understood that, to look natural, a mounted animal skin has to begin from the inside, like the animal itself. In the early years of this century, he not only developed an effective method of realistically mounting large and small mammals but introduced and perfected techniques for making convincing simulations of their natural environments.

The Akeley Method begins in the field, where the specimens collected are photographed and carefully measured. The dried and salted skins are sent back to the museum along with the skeleton. At the Museum, a preparator makes a small clay model, exactly to scale, of the animal in the desired position. Upon arrival, the skeleton is mounted on an iron and wooden armature based on the model(1). A clay figure is carefully modeled to the measurements made in the field(2). When this model is perfect in every detail, the taxidermist makes a plaster mold(3, 4). The final mannequin to support the skin is made by lining the mold with layers of wire mesh, burlap, and glue which are reinforced with wood(5). Hollow and less than a half inch thick, the mannequin is light, waterproof, and very durable(6).

The tanned skin, treated with arsenic to prevent insects from destroying it, is pasted and pinned on the mannequin to follow all the muscle contours. Preparators use waxed linen thread to sew incisions on the legs and stomach of the skin(7). The antlers, horns and hoofs of the animal are used, and glass eyes, embedded in papier mache, are set in place. After the skin dries, fleshy parts around the eyes and nostrils are modeled in wax and colored with oil paint(8). The mounted animal can now take its place in the museum habitat group.

The Akeley Method of Taxidermy

1.

Photo: AMNH

2.

Photo: AMNH

3.

Photo: AMNH

4.

Photo: AMNH

5.

Photo: AMNH

6.

Photo: AMNH

7.

Photo: AMNH

8.

Photo: AMNH

Pre - Visit Activity

Hector, The Collector

(Kindergarten through 3rd Grade)

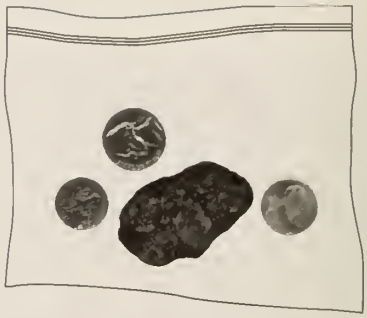


Illustration: Jay Holmes

The American Museum of Natural History is the largest natural history museum in the world and a preeminent research institution. The Museum's collections total 36 million artifacts and specimens. The vast majority of these collections are not on display but are maintained for study by Museum scientists and other researchers. The following activity will introduce children to collections and what they can learn from collections.

Objectives

Students will:

- classify objects by recognizing like characteristics;
- learn to observe, record and interpret data;
- understand the purpose of collecting;
- learn about the collections at the American Museum of Natural History.

Materials

- a variety of small items with similar characteristics such as:
- 4 plastic dinosaurs, 4 rocks, 4 twigs, 4 shells, 4 coins, 4 erasers
- plastic baggies

Advanced Preparation

Prepare plastic baggies with items in advance so that each group will have one. Place three like items in each bag along with one unlike item (three plastic dinosaurs and one rock).

Procedure

- **Warm–up** Ask children if any of them collect things or have family members who collect things. Call on volunteers to describe the collections. Write children's responses on the board or on chart paper. Explain that people treasure collections. Every piece of the collection has a special meaning or place. The zoo, for example, is a collection of animals. Each animal in the zoo is different and can teach us something about the way animals live and behave. Tell children that an imaginary boy named Hector mixed up his collections and they are going to straighten them out.

- First, model for children how to identify similar characteristics amongst items. Hold up three pencils (should be different colors and lengths) and a piece of chalk. Ask children to tell you which items are similar and to name how they are similar. (The pencils are all used to write on paper, are made of wood, have lead, have a pink eraser on one end, are the same shape.) Ask children to describe the chalk. (used to write on chalkboard or sidewalk, soft material.) Ask children which three items would go together in a group. (The pencils.)

- Have children work in cooperative learning groups of three to four. Distribute one baggie to each group. Have groups decide which items in the bag belong together and which do not. Give groups time to identify similar characteristics such as shape, size, color, texture, function, and so on, and to report their findings.

- Tell children that they will be visiting the American Museum of Natural History. Explain that the Museum is a place that has a lot of collections. There they can see dinosaur fossils, people and how they live, fish and other sea animals, mammals, birds, reptiles, and many more things on exhibit. (Remind children that none of the animals in the exhibits are alive.) Tell children a bit about the exhibits you plan to take them to see.

- Ask children to name specific things they think they will see on their visit. Write their responses on chart paper. After, have children compare their predictions with their experiences at the Museum.

Pre - Visit Activity

Objects of Knowledge

(2nd through 6th Grade)

Kwakiutl Mask

Photo: AMNH

Since 1869, the American Museum of Natural History has been an international leader in scientific investigation. The Museum has sponsored thousands of field studies and expeditions and is home to more than 36 million artifacts (simple object that shows human hand work) and specimens (an item or part typical of a group or whole, such as a fossilized dinosaur bone) Each year over three million people visit the Museum to view the permanent halls, special exhibits, and to participate in educational programs.The following activity will help students understand the purpose and importance of collections. It will lead them to an understanding of why museum collections are so treasured.

Objectives

Students will:

- examine why people collect objects;
- explore the purpose of museum collections;
- recognize the value of museum collections.

Materials

- objects that students find at home or in the classroom

Advanced Preparation

- Ask students who have collections such as baseball cards to bring their collections in to present to the class.

Procedure

- **Warm–up** Ask students who have brought in collections to present their collections to the class and to tell why they collect. Lead students in a discussion of how collecting can benefit the collector and others. For example: what kinds of things are collected in a library? (books, periodicals, etc.) How do they benefit us? (Books provide enjoyment, learning opportunities, etc.) Ask students to name and briefly describe other collections they know of.

- Tell students that museums have many different collections under one roof. Each collection contains a variety of objects — each one providing a piece of information about the particular collection. When viewed as a whole, the objects can tell a story or teach a concept. Ask students to describe collections they have seen or provide the following example.

  The Akeley Hall of African Mammals at the American Museum of Natural History shows the various habitats of Africa and the animals that live in each habitat. By viewing each exhibit a person gains an understanding of the animals and habitats of Africa. Tell students that today they will examine the purpose of museum collections as displayed in exhibits.

- Have students work in cooperative learning groups of three to four. Ask each group to make a collection of three to four objects. The objects should be related in some way so that they either tell a story or teach a concept. Students may do the activity as a homework assignment or in class using objects available in the classroom.

- When groups have collected their objects allow them four minutes each to present their collection to the class, tell how the objects are related, and why the collection is important.

- **Conclusion** Help students conclude that collections contain valuable objects that help us understand the people, cultures, animals, and environments of our world. Have students make predictions about what they will see and learn on their visit to the American Museum of Natural History. Have them write down their predictions. Use them as a discussion starter for after the visit.

The Power of Observation

(3rd through 6th Grade)

Chimpanzee Skull

Photo: AMNH

The collections at the American Museum of Natural History contain a vast number of artifacts and specimens from places and cultures throughout the world. Each object contains a lot of information. One can get an overall view of an object by looking at it. By examining it closely, one can gather a lot more information that can be used to make inferences, and draw conclusions. The following activity will help students practice their observation skills. They will learn to view an object critically and to use their observations to draw conclusions about what they see.

Objectives

Students will:

- learn to carefully observe an object;
- make inferences and draw conclusions about an object based on their observations;
- connect concepts to arrive at a new understanding;
- understand how scientists use the skill of observation in their work.

Materials

- objects such as shells, staplers, rulers, stones, etc.
- paper bags
- pencil and paper

Procedure

- **Warm–up** Have students examine a pencil. Ask them to describe its color, shape, the materials it is made of, and any other characteristics. Ask students how the pencil's features help the person writing. (shape of the pencil helps person grip it, pointed lead aids writing, eraser helps correct mistakes, color makes it easy to find.) Point out to students that everyday we make observations about hundreds of objects that come into our lives. We use these observations, often without even being conscious of what we are doing, to make inferences and to draw conclusions. Explain that the activity will help students learn to observe an item closely.

- Have students work in pairs, sitting back–to–back in chairs for the activity. Place one object in each bag. Distribute one bag to each pair, making sure that only one (the describer) looks into the bag.

- Tell students that one partner will use his or her power of observation to describe the characteristics of the item to the other partner. After each clue the second partner will have an opportunity to guess what the item is. Suggest students describe the weight, size, shape, color, and texture of the item along with any other outstanding features. Once the identity of the item has been guessed, the partners should make inferences and draw conclusions about the object.

- When students have finished, have them put the objects back in the bags and trade with another pair. The second partner will now describe the object while the first partner tries to guess what it is.

- **Conclusion** After the activity have students discuss what they learned about their own powers of observation. Help students conclude that there are various levels of observation. Learning to observe carefully will enable them draw conclusions about an object's function, an animal's behavior, or make other inferences about the world around them.

- *Alternate activity* For activity –oriented or kinesthetic learners, place objects in paper bags, but instruct students not to look. Have them instead identify the various features of the object using the sense of touch, sound and smell. Have them communicate their findings to a partner who will try to guess the object's identity.

The field of Geology is one that applies the methods and theories of many sciences to understand the Earth and its surroundings. Using the physics of earthquake waves traveling through the Earth to the crystal chemistry of minerals, geologists strive to understand how the Earth works, how it evolved and what are the governing processes.

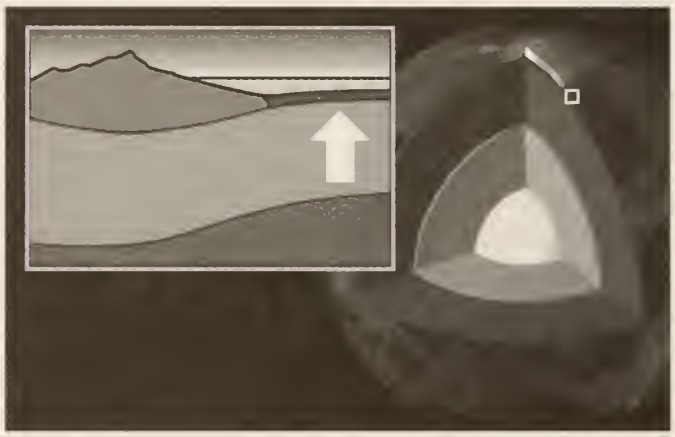
Over the last thirty years a revolution in our understanding of the Earth has occurred. With the arrival of new sensors, computers and other tools a wave of data has lead to a broader and deeper picture of the dynamic nature of the Earth. The theory of plate tectonics has provided a unifying context to organize these new data and leads scientists to new questions.

A group of 12 scientists in the Department of Earth and Planetary Sciences at the American Museum of Natural History is currently conducting research on matters that cover a wide range, from planetary formation to ore deposits. They devise experiments, apply complex analytical techniques and do field work around the globe as they pursue answers to their questions. For example, they measure the mineral composition of meteorites to gain information on the composition and early history of the solar nebula from which the earth formed; they examine rare samples from deep in the Earth's crust which contain platinum in order to understand how platinum deposits form; they study rocks recovered from the ocean basins to understand the workings of plate tectonics; they investigate how gases dissolve in magmas to understand the nature of volcanic gases and their influence on climate; and they conduct experiments on the conditions found in the Earth's mantle hundreds of kilometers below the surface to understand how minerals behave at these extremely high pressures and temperatures.

By visiting the Museum's Halls of Meteorites, and Minerals and Gems your students can see rare specimens from outer space and their own "backyards." Understanding these minerals and the story they tell us about the Earth is important because it is the physical world that all organisms must adapt to. Major evolutionary upheavals are often related to changes in volcanic activity, rearrangements of continents or other changes in the physical Earth. The Earth is the stage on which all life developed and evolves.

Plate Tectonics

Experiments such as "If the Earth were Honey and Fluff", on the following page, will help students understand why dense materials are at the core of the Earth. The following information on plate tectonics will help them extend their knowledge of this subject. You may duplicate these pages for students.



Illustrations: AMNH and C. Wave

1.

Some of the Earth's features like Mt. Everest and the Grand Canyon seem immense to us. But they are actually part of a very thin rocky crust that forms the Earth's surface. The light rock of the crust is only a few miles thick under the oceans, but as much as 25 miles thick under the continents. This rigid crust and upper part of the mantle float on a layer of more plastic rock deeper in the Earth's mantle that begins about 60 miles below the surface.

2.

The crust is divided into large pieces called plates that form the continents and ocean floor. Boundaries between plates are marked by high levels of earthquake activity. These earthquakes are caused by movements between plates as they float across the plastic layer of the mantle. Earthquakes can result in movements as large as 30 feet. But, on the average, plates move only a couple of inches a year. We see three basic kinds of movement.

3.

First, plates move apart as molten rock rises up from the mantle through fractures in the crust. This often occurs at the bottom of an ocean and causes underwater mountain ranges to form.

4.

Second, plates can move toward one another. This causes one plate to dive down under the other creating a trench on the ocean floor. This collision can also uplift enormous mountain ranges on the continent.

5.

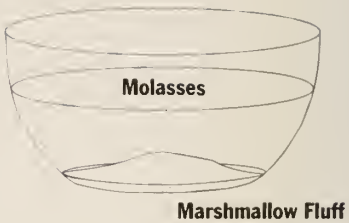
These two kinds of movements recycle the crust, so that new crust is formed where plates move apart and crust is destroyed where plates collide.

6.

Finally, plates can slide past one another, creating fault zones thousands of miles long. Over the last 500 million years, these movements have greatly altered the positions of continents and oceans on the Earth's surface. This in turn has greatly affected the evolution and distribution of animals and plants both in the oceans and on the continents.

If The Earth were Honey and Fluff

(3rd through 6th Grade)



The Earth is made of many different materials. Some are very dense, such as the nickel and iron of the Cape York meteorite. Other materials such as the granite stone that parts of the Museum buildings are made of are less dense. Dense materials are found at the very center of the Earth. Less dense materials are in its outer layers. In this activity students will examine the density of two materials and investigate what happens when they are put together.

Objectives

Students will:

- measure the density of two materials;
- examine what happens when the two materials are put together.

Materials

- one clear mixing bowl;
- three to four cups marshmallow fluff
- one to two quarts light molasses
- two measuring cups or beakers
- a balance scale

Procedure

- **Warm–up** Ask student to think about two balls the same size: a golf ball and a styrofoam ball. Point out that the volume of the balls are the same, but the golf ball has more mass or density. Ask students to give you examples of materials that have a high density (iron, lead) and a lower density (aluminum).

Part 1

- First have students find the density of two materials and record their findings on a sheet like the one below.
- Use the balance to find the mass of the measuring cup (a). Fill the cup to a specific point. Record the volume of the material (e.g., 50 milliliters of molasses).
- Use the balance to find the mass of the beaker **and** the material (c). To find the mass of the material alone (b), subtract the mass of the beaker (a) from the mass of the beaker and the material. (b=c – a).
- To find the density of the material, divide the mass of the material by the volume of the material (d – b). Have students compare their results to determine which is denser molasses or marshmallow fluff.

Part 2

- What would happen if the Earth was made out of marshmallow fluff and molasses? To find out place a dome of marshmallow fluff about 3/4" high in the bottom of the bowl. Thin out the fluff near the edges.
- Add molasses until it is about 3" deep. Observe what happens. Draw a diagram to show the results of your experiment. Which material ends up on top? Why?
- Allow time for students to discuss the results of their experiment and draw conclusions about why dense material is at the core of the Earth.

Material	Mass of Cup	Volume of Material	Mass of Cup and Material	Mass of Cup and Material	Density of Material
Molasses					
Marshmallow Fluff					
	(a)	(b)	(c)	c – a = d	$\frac{d}{b}$

Paleontology

is the science which investigates the life of past geological periods as revealed by fossil remains. By studying the history of life on Earth paleontologists help us recognize that this history is a continuum. Paleontology is not necessarily the study of extinct life forms. Through the examination of past events, fossil hunters help explain present patterns of life and lend to our understanding of the immense complexity of the world in which we live. In order to study and understand the development of organisms, these scientists employ knowledge gathered from geology, biology, botany, meteorology, and other fields. Advances in these fields have helped paleontologists piece together the intricate puzzle that the past presents. Plate tectonic theory, radioisotope dating techniques, scanning electron microscopy, and other scientific tools have helped answer many long–standing questions about evolution and have given rise to many more.

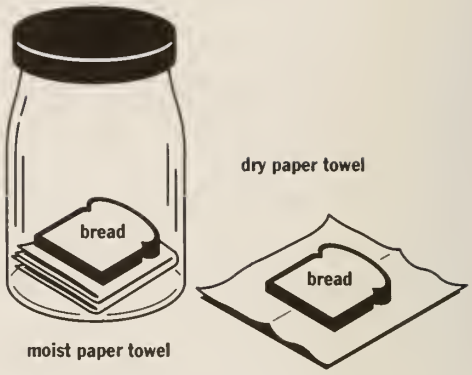
At the American Museum of Natural History, paleontological research contributes to several scientific departments but plays a major role in at least three: vertebrate paleontology (the study of fossil remains of animals with backbones); invertebrates (the study of animals without backbones); and anthropology. The Museum's Vertebrate Paleontology Department boasts one of the largest fossil collections in the world, and recent finds by scientists in the department have been headline–making events. Most notable is the discovery of a dinosaur embryo in the Gobi Desert of Mongolia, the first find of its kind. This discovery is just one of many examples of the department's contributions to our understanding of the nature of life on Earth.

Anthropologist who study early human ancestors are also conducting paleontological research. Significant fossil finds have helped scientists trace our ancestral roots and develop a comprehensive view of our own family tree.

Some of the best places in the Museum to experience the fruits of paleontology are the Hall of Human Biology and Evolution, the Lila Acheson Wallace Hall of Mammals and Their Extinct Relatives, and, opening in the Spring of 1995, the Halls of Saurischian and Ornithischian Dinosaurs. The Museum's Education Department, in conjunction with other scientific departments, offers classes for the public and for school groups on the subject of paleontology as well as other subjects exhibited within the Museum.

The Mummy vs. The Slime

(3rd through 6th Grade)



A fossil is any evidence of prehistoric life that is at least 10,000 years old or older. The most common mammal fossils are bones and teeth, but sometimes footprints or skin impressions are found. Fossils can be found in ancient river beds, caves, ocean floors, bogs, volcanic ash falls, and tar pits. Finding fossilized teeth and bones is rare. Finding fossilized skin is even rarer. That is because soft organic matter usually rots away before the fossilization process is completed. The following activity will enable students to understand why soft organic matter rarely becomes fossilized.

Objectives

Students will:

- observe the effect of the environment on the preservation of soft organic material;
- make inferences as to how the dinosaur mummy (*Expedition Passport,* pages 42-43) was fossilized.

Materials

- two slices of bread (or apple)
- a jar with a tight lid
- two squares of paper towel (4" x 4")
- a dish of water

Procedure

- **Warm-up** Remind students of the mummified dinosaur they saw at the Museum. Explain that finding fossilized dinosaur skin is extremely rare because the fossilization process generally preserves only bone. Explain that skin and tissue are soft organic material. The following activity will help students observe the affect of the environment on soft organic matter.

- Have students moisten one piece of paper towel with water and place in the bottom of the jar. Have them place a slice of bread on top of it. The lid should be replaced and the jar put on a desk, shelf, or widow sill where it will not be disturbed.

- Have students place the second slice of bread on a piece of dry paper towel and place it on a desk, shelf, or window sill where it will not be disturbed.

- Allow the two slices to stand for a week. Every day or two students should observe the two bread slices and record their observations.

- At the end of the week have students describe the condition of the two slices. Use the following questions to guide the discussion:

  1. Which of the two slices has changed the least?

  2. If the two were to become buried in sediment and become fossilized, which one would give you a better idea of what the original object looked like?

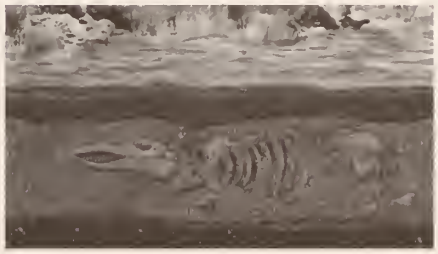
  3. What can you say about how environment affects the preservation of soft tissue?

  4. What happened to the skin, tissue, and organs of most dinosaurs?

  5. Based on what you have learned, how do you think the dinosaur mummy you saw at the Museum became fossilized?

How Fossils Form

Fossils can form in several ways. Here is one way fossils can form. Suppose a mastodon were to drown in a river during a flood. It is quickly buried in sand and mud. Everything rots away except the hardest minerals in its bones and teeth. Minerals in the water running through the ground are deposited in the bones. Thousands (and sometimes millions) of years pass. The remains are more deeply buried as sediment accumulates. Geologic activity causes the riverbed to be lifted to the surface. Wind and water erode the rock, and the fossilized bones are exposed.



How do paleontologists decide how old a fossil is?

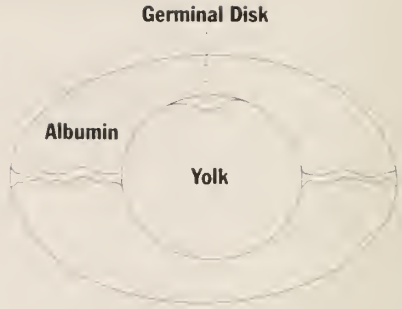
To find out how old a fossil is, paleontologists have to figure out the age of the rock it's found in. Since rock layers are laid down one on top of the other, they know that fossils found in lower layers of rock are older than fossils found in higher layers. Layers of volcanic ash or lava may be found in the sequence of sedimentary beds that also contain the fossil. Some atoms in volcanic rock decay radioactively – they break apart to form new atoms at a known rate. Geologists can tell how old the rock is by counting the new atoms. Once they know the age of the rock, they know the approximate age of the fossil that is found in it.

How do paleontologists know where to dig for fossils?

Most fossils are found in a type of rock called sedimentary rock, which forms when sand or mud settles on the bottom of streams, lakes, or oceans. After millions of years, what was once the ocean floor can be pushed to the Earth's surface. Geologists make maps that show where rocks of different ages are exposed on the surface of the Earth. Paleontologists use these maps to look for fossils. Sometimes people who live in these areas find fossils, and contact paleontologists. If the area is rich in fossils, a paleontologist might spend a lot of time there studying them.

Investigating Eggs

(5th through 6th Grade)



During the Carboniferous period of Earth history a great step forward occurred in the evolution of vertebrates. It was the appearance of the amniote egg which occurred at the time that reptiles had become established on land. It freed aquatic organisms from reproducing only in aquatic environments.

The egg contains a large yolk that provides nourishment for the embryo. It also contains two sacs. The amnion is filled with liquid and contains the embryo. The other is the allantois, which collects waste products produced by the embryo. An outer membrane, the chorion, surrounds the sacs. The entire structure is enclosed by an outer shell that is tough enough to protect the embryo, yet porous enough to allow oxygen to pass into the egg and carbon dioxide to pass out of it. In this activity, students will investigate the structure of an egg and examine a developing embryo.

Objectives

Students will:

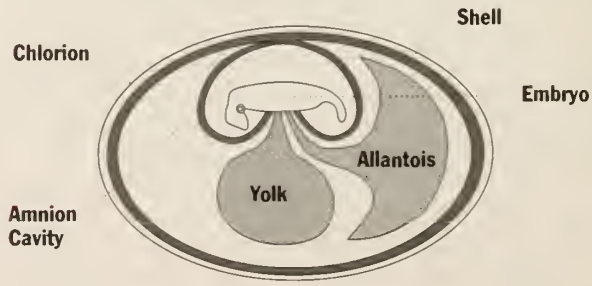
- examine the structure of an egg;
- identify the various parts of an egg and name their functions;
- examine how an embryo develops within an egg.

Materials

- chicken eggs either store-bought or fertilized
- white vinegar
- large beakers or wide-mouth jars
- large spoons

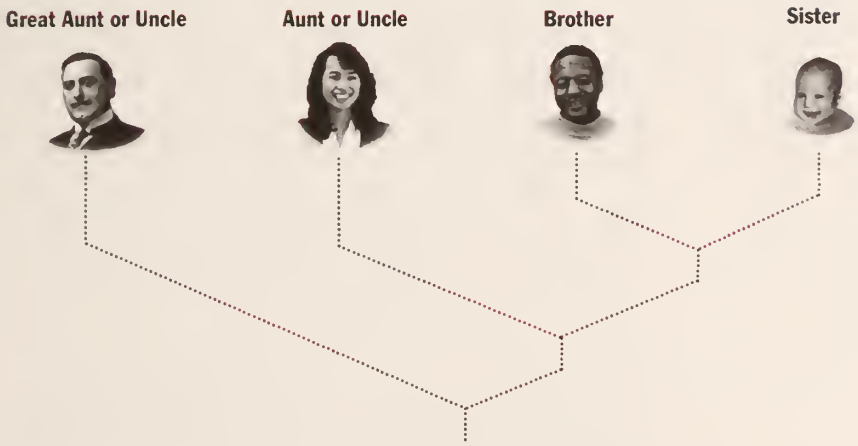
Procedure

- **Warm–up** Lead students in a discussion of animals that reproduce by laying eggs. Point out that reptiles were the first to lay amniote eggs . Tell students that they will examine the structure of an egg and how an embryo develops within it.
- Pour enough vinegar into the beaker to cover the egg. Carefully place the egg into the beaker. Use the spoon to keep the egg submerged. What do you see? (Bubbling as the acetic acid of the vinegar dissolves the egg shell.) This activity was first published in the book, *The Fossil Factory*, by Niles Eldredge (Addison-Wesley, 1989). It is used by permission of the author.
- Leave the egg in the vinegar for 24 hours. Then remove it using the spoon. Carefully examine the egg. Identify the following:
- albumin – the clear liquid of the egg which supplies water to the developing embryo.
- yolk – the central yellow part of the egg which is the food supply for the embryo.
- germinal disc (if the egg has been fertilized)—this is the site of the developing embryo.
- chorion–the outer membrane that keeps the water in, but allows oxygen to pass to the egg, and carbon dioxide from the respiring embryo to pass out.
- *Alternate Activity* Fertilized amphibian and chicken eggs are available from biological supply companies. The amphibian eggs provide students with the opportunity of observing the development of the embryo inside its transparent egg without shells. Have students use their observations skills to compare both eggs noting how they are similar and different.



Understanding Cladistics

A.



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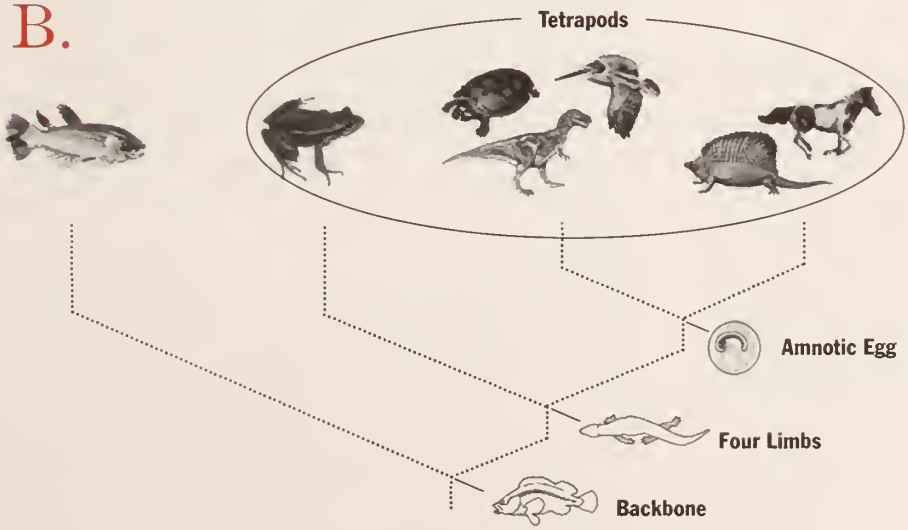


Cladistics is a method of scientific analysis for reconstructing evolutionary relationships among animals. The American Museum of Natural History has played an important role in developing cladistics, which has been around for about 20 years. Cladistics shows that humans are intimately linked to the other organisms on Earth through a long and complex history of evolutionary changes.

People trace their family history by compiling a family tree (cladogram a). In a similar way, scientists reconstruct evolutionary history by compiling evolutionary trees (cladogram b) that show close and distant relatives. Illustrations at branching points on the tree represent physical features that have changed during the course of evolution. Each featured evolved in an ancestor and was inherited by the ancestor's descendants. For example, animals with four limbs (circled) inherited this feature from the first animal with four limbs. We may not know what this ancestor looked like, because we've not found fossils of every animal that ever lived. But we do know that the ancestor had four limbs because we can see four limbs in the descendants. In the fossil exhibition halls of the Museum, each animal has been placed with its closest evolutionary relative. Walking along the main path of the fossil exhibition is like walking along the trunk of an evolutionary tree. There are branching points along the main path that represent new evolutionary features such as backbones or limbs. At each branching point you can walk off the main path to explore a group of closely related animals such as bony fish or frogs.

Construct a Cladogram

(5th through 12th Grade)

In the new dinosaur and early mammals halls, specimens are arranged by their evolutionary relationships to each other. The halls are laid out using the structure of a cladogram. The cladogram is a tool scientists use to learn more about the evolutionary relationships between organisms. A cladogram is a diagram that displays the characteristics that different animals share (cladogram b, page 17). Organisms are ordered in such a way as to describe close and distant relatives: organisms that share many characteristics are closely related, organisms that share only a few characteristics are distantly related. In grouping organisms by shared characteristics, a clearer understanding of the course and process of evolution may be achieved.

In order for scientists to identify and determine the similarities and differences between different species of organisms, they describe their physical characteristics. They then group the animals which share the most characteristics together. One way of relating this process to students is to use the mathematical concepts of sets and subsets. For example, if you look at cladogram b on the preceeding page you will see that animals with 4 limbs is a subset of animals with a backbone. All animals with 4 limbs have a backbone, but an animal (such as a fish) may have a backbone without having 4 limbs. The following activity will introduce students to the cladististic method of organizing the relationships between groups of animals.

Objectives

Students will:

- review the mathematical principle of sets;
- learn to utilize a method scientists have devised to classify the relationships between organisms.

Materials

- a variety of similar objects collected in plastic baggies (about 10-12 objects per bag)
  (sample bag: ten penny nail, carpet tack, brad, roofing nail, thumb tack, paper clip, large staple, small staple, screw, bolt.)

Procedure

- **Warm-up** Discuss with your students the reasons why scientists group different organisms together. (In order to identify them, to understand how they live in the world, to understand how they are similar and different, in order to understand their evolutionary relationships) Ask students how scientists do this. (Observe the organisms, describe them, look for things they have in common.)

- Demonstrate for your students the process of creating a cladogram using coins of different denominations. Take 4 coins: penny, nickel, dime, and quarter. Ask students what all of these objects have in common. (They are all coins.) The set that they all belong to is "American coins." Now ask the students if any one coin has a physical characteristic that makes it different from the others. (Suggest color differences. They should pick the penny.) What do all the other coins have in common? (They are silver colored.) These three coins now form a

a subset of the most inclusive set. This subset is defined as "silver colored coins". Ask the students now to see if there is any one coin that stands out as having a characteristic that makes it different from the other silver colored coins. (Suggest texture of the edges as the defining characteristic.) Using this criteria they should select the nickel, which has smooth sides. Ask the students, what the other coins have in common. (They have rough edges.) "Rough edges" is now the subset of the set of silver coins. Ask the students if there are any differences between the dime and quarter. They may select any difference. Both of these coins are now subsets of the set of rough edged coins. While you are demonstrating this procedure, you may want to draw on the blackboard a group of nested circles, as shown in diagram 1. After completing the groups of subsets, you should then draw a cladogram, as shown in diagram 2. Explain to your students that the cladogram is just another way of graphically ordering information to more clearly understand it. Explain that this is the technique that scientists at the Museum use to understand the relationships between animals in the halls of dinosaurs and early mammals

- Have students work in cooperative learning groups. Distribute one bag of objects to each group. Tell them that their assignment is to create a cladogram using the objects and the method that you all used as a group with the coins. Have the students examine their objects and identify a characteristic that defines the entire group. Then, have them select one object that differs from the rest in one characteristic. They should then identify the characteristic that all the other objects have that the one selected does not. That characteristic is the defining characteristic of the first subset. You may want the students to create a diagram similar to diagram 1 on a large piece of paper, with the name of each subset written within each nested circle. The students should continue with this method, selecting one new object from each set and defining the remaining objects by a characteristic they all share but the separated object does not until there are only two objects left. They should then identify a characteristic that separates those two objects. If you are using the nested circles as the initial graphic method, the students should then draw a cladogram of their objects as shown in diagram 2.

- After students have completed their cladograms, have them compare them. Are they all the same? (Most likely not.) What are the similarities and differences between cladograms? What insights does this give the class as to the complexity of understanding the relationships between species in evolutionary studies?

Diagram 1

Diagram 2

diagrams: Emily Ogrinz

Making a Fossil Cast

(1st through 6th Grade)

Fossils are comprised of rock and are very heavy. Because of this dinosaur skeletons cannot be easily mounted and displayed. Instead, casts of actual fossils are made in a lighter material such as a polymer and displayed in exhibits. Fossil casts are also made so that more than one museum or research facility may exhibit or examine a rare but important fossil. In this activity, students create casts of objects in order to understand fossil types.

Materials

- paper cups (one per student)
- plaster of Paris
- mixing bowl and spoon
- measuring cup
- water
- modeling clay
- assorted shells

Procedure

- Review with students why fossil casts are made. Then pass out a paper cup and ball of clay to each student. The clay should be pushed down into the cup and smoothed out. It should fill about one third to one half the cup.

- Have each student choose a shell and firmly push the side they find most interesting into the clay. Then have students gently lift the shells out of the clay. A clear impression of the shell should remain. If not, have students smooth the clay over and try again.

- Mix the plaster and water (two parts plaster to one part water). Once the plaster has been mixed you will need to move quickly because it begins to harden immediately.

- Have students fill the paper cups with the prepared plaster and put aside to dry overnight.

- After the plaster has hardened, have students tear the paper cups off the plaster and clay. Have them gently separate the plaster from the clay. The plaster should show a reproduction of the shell.

Bones, Bones, Bones

The student sheet for this activity appears on the facing page.

Students will:

- investigate skeletal structures;
- examine how paleontologists reconstruct dinosaur skeletons.

- Duplicate the students sheet for your students. Have them bring the assembled dinosaur and extra heads with them on their Museum visit.

Bones, Bones, Bones

1. Cut out bones along the dotted lines. Put them together to make dinosaurs.
2. Do you know the names of the dinosaurs? Come to the museum to find out.

When it comes to measuring the health of an environment, it is important to learn about the history of its biodiversity (the variety of species within the environment). This involves ecology (the study of interactions between these species and their environment). Biodiversity studies and other aspects of ecology are fundamental to many scientific disciplines and are represented in many different ways within the Museum's walls.

Behind the scenes, the Museum is alive with scientists cataloging the biodiversity and studying the ecological interactions of many habitats. At any given time, entomologists may be studying a new species of insect, ichthyologists may be investigating the relationship between a species of fish and one of its parasites, and ornithologists may be analyzing data about the population dynamics of an endangered species of bird. Biodiversity and ecology can also be explored in the exhibit halls of the Museum, where many spectacular species of plants and animals are displayed in beautiful dioramas that simulate their environment.

Unfortunately, in many places of the world, these environments and their plants and animals are disappearing. It has, therefore, become urgent that people throughout the world collaborate in their efforts to learn as much as possible about these environments. In response, the American Museum of Natural History has created the Center for Biodiversity and Conservation. It unifies the Museum's many scientific endeavors, its many research facilities, and its programs at other institutions around the world. The information gathered through this and other projects help us learn how to more effectively lessen our impact on the environments around us. Museum scientists are among the first to notice and understand declines in environmental health. Their discoveries have been an important part of environmental protection.

The Museum's exhibits also help to protect the world's environments. They educate the public not only about biodiversity, but about the science that takes place in the Museum as well. The curators play important roles in the design and construction of the exhibits often incorporating the findings of their research. A scientific trip to Africa or Antarctica may result in some outstanding photographs that could be included in an exhibit. A trip to the Polynesia may provide new specimens of plants or animals. The specimens, photographs, and other items collected during these trips do not all end up in exhibits. In fact, most of them become part of the Museum's extensive world–renowned collection. But, what is available for public view in the halls is so diverse that most who visit the Museum leave with a sense of awe and respect for the natural world.

The Web of Life

(2nd through 6th Grade)

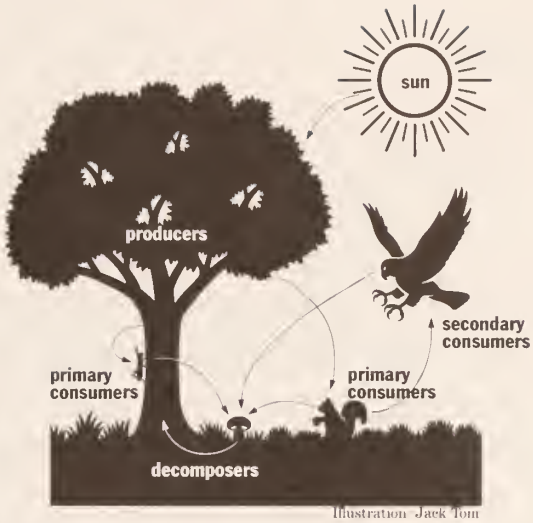


Illustration Jack Tom

The dodo, an inhabitant of Mauritius, became extinct in the late 17th century when it was over-hunted by sailors. It wasn't until 1973 that Dr. Stanley Temple realized the impact that the loss of the dodo had. A species of tree, *Calvaria major*, was dependent on the dodo for seed germination. The 13 trees of the species were all 300-years-old or older. The youngest tree began growing around the time the dodo became extinct. Although the trees were producing fertile seeds, none were germinating. The dodo was the missing factor. To germinate, the seeds needed to be partially digested in the dodo's gizzard. Scientists fed some seeds to turkeys whose digestive systems are similar to the dodo's. The results were that three out of every ten seeds germinated. This is one example of the interdependence of species within an ecosystem.

Objectives

Students will:

- understand what a food web is;
- explore the interconnection between living things.

Materials

- two large balls of string
- two sets of 15 to 20 index cards with the names of various plants, animals, and ecosystem resources written on them (one per card). Sample set: soil, grass, water, sun, mouse, nut, raccoon, squirrel, fruit, tree, deer, seeds, frog, earthworm, snake, plant-eating insects, hawk, spider, coyote, bird, bobcat, human.

Procedure

- **Warm-up** Ask students to describe the path that food takes from the farm, cattle ranch, or orchard to their dinner tables. Write their suggestions on the board. Ask what would happen if the truck delivering the food broke down. Point out that we are dependent on a chain of events in order to get our food. Explain that in nature, plants and animals also depend on one another for food. Display a food web to students or have a volunteer draw one on the board. Explain that the activity they will do helps demonstrate the interconnection among living things.

- Have students form two groups, each group making a large circle. Give each group a set of cards, one for every student.

- Give the string to the student with the sun card. Have the sun choose an organism that is dependent on it for survival (plant needs sun). The sun retains the end of the string and passes the ball to the plant creating the first string of the web. The plant chooses an organism that is dependent on it for survival, such as a plant-eating insect, and passes the ball of string to the insect.

- After students have passed the ball several times, suggest to them that the organism holding the string has just died. Ask: What eats dead or decayed matter? (insects, earthworms) The organism holding the string passes it on to an insect or earthworm. The game continues until all the students are holding the yarn by at least one point. There will be a large web of yarn in the circle.

- Allow students time to discuss their observations about the activity. Ask them what would happen if one of the organisms or elements disappeared. To demonstrate, ask the student who has been passed the string the most often to drop it. Have students who are directly affected by the loss gently tug the string. As they tug, ask other students affected to gently tug as well until all of the students are affected. Help students conclude that even the loss of the smallest insect will have a profound affect on the other organisms of an ecosystem.

Bird Adaptations

(3rd through 6th Grade)

Every species of bird is adapted to its own habitat and has its own unique body shape and size. Although there are many ways in which species of birds differ, it's usually the feet and/or the beak that shows the highest degree of adaptation. These changes evolved through competition over food resources and habitat. This activity will help students look closely at a bird's feet and beak to understand how they have adapted to meet each specie's individual needs.

Objectives

Students will:

- compare the beaks and feet of a variety of birds;
- understand how feet and claws have adapted over time to meet each specie's needs.

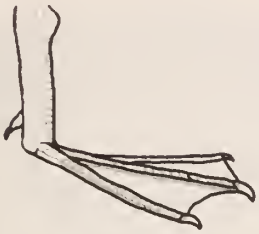
Materials

- 15 – 20 pictures of birds (showing beaks and feet) cut from nature magazines or calendars
- a copy of Bird Beaks and Feet (facing page) for each student.

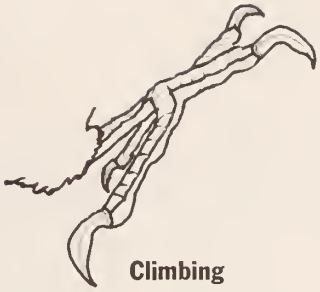
Procedure

- **Warm-up** Write the words *ostrich* and *penguin* on the chalkboard and, if possible, display a picture of each. Have students work in small groups to brainstorm what they know about each bird, including physical features, habitat, rearing young, behavior, etc. Have groups report back to the class with their ideas. As groups give their ideas, create a concept map on the chalkboard. Point out to students that each bird is well–adapted to its environment. Ask students how the ostrich's feet and the penguin's webbed feet help each survive in their environments. Tell students that the activity they will do will help them identify the various ways birds use their beaks and their feet.
- Write *running, gripping, swimming, climbing, perching,* and *wading* on the board. Distribute Birds' Beaks and Feet to students. Have them identify the various birds' feet and how they are used. Then distribute the pictures to students and have them, one at a time, decide which category their particular bird belongs in. Have students look carefully at the pictures and discuss to which behavior the feet are best adapted.
- Repeat the activity with birds' beaks. Direct students to birds' beaks. Have them suggest what types of food each bill is best adapted to and how the bill is used to obtain food. Have students look carefully at the pictures and discuss how each bird's beak is shaped to meet its needs.
- Have students observe birds around the school during recess or lunch break. Discuss how the birds' feet differ from the birds they saw in the pictures. Suggest students draw pictures of the birds they know or design their own birds. If they design their own, they should first choose an environment and a lifestyle for the bird. They should consider size, shape, feathers, and color. They should then design a body, feet, legs, and beak to suit the bird, its lifestyle and environment.

Birds' Beaks and Feet

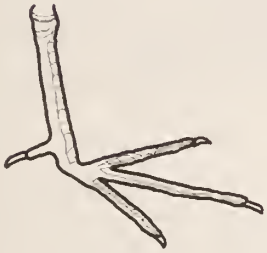


Swimming



Climbing

Perching



Wading

Scratching

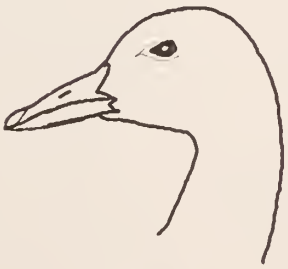
Preying

Running

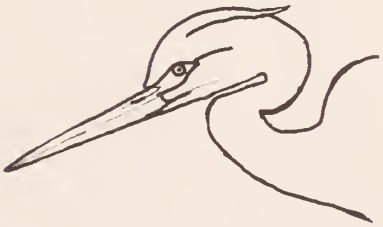
Seed Eating

Ground Feeding

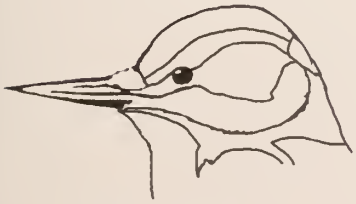
Grass Eating



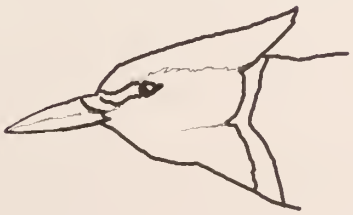
Straining



Fish Eating



Insect Eating

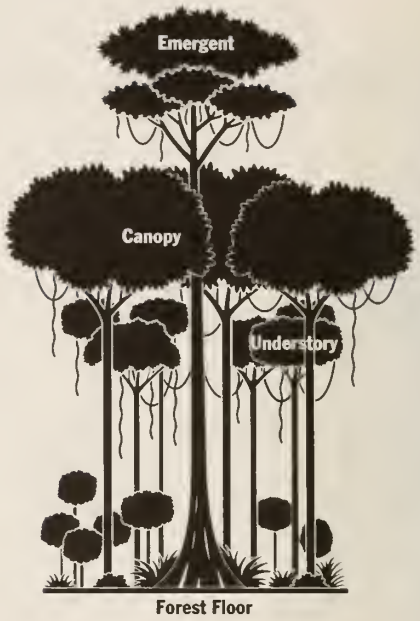


Seed, Berry and Insect Eating

Preying

The Habitat Game

(Kindergarden through 3rd Grade)



Most animals throughout the world are decreasing in numbers because of diminishing habitats. Forests are being cleared for farming, mining, and other industries, leaving animals with less and less areas to live in. The following activity will help children understand the affect of diminishing habitats on animals.

Objectives

Students will:

- learn about the animals that inhabit a rainforest;
- understand how cutting down a rainforest affects the animals that live there.

Materials

- Pictures of rainforest animals cut from nature magazines or calendars

Procedure

- **Warm-up** Display the pictures of the rainforest animals. Lead children in a discussion of the animals that live in a rain forest. Include the emerald tree boa, sloth, parrot, leopard, tree frogs, insects, and other animals. Discuss what each animal eats, where each animal lives (in the trees, on the ground), and what some of the behaviors are. Tell children that the rainforest is being cut down and that animals that live there are being threatened. Tell children they are going to play the Habitat Game.

- For each of the animals of the rainforest, choose one child to act as that animal. The rest of the class will be the rainforest. To make the rainforest, have two children stand opposite each other holding hands. Have three children stand around the first two holding hands. Have five children stand around the three holding hands. Continue in this way until the rainforest is formed. Children should be standing at arms length to allow space for the rainforest animals to move around.

- Have the animals go into the forest. Suggest they each find a space where they can have a lot of room. Explain that they cannot move beyond the outer circle of trees. Have a child in the center of the forest describe what he or she sees when looking through the trees. Suggest the animals move through the forest trees. Call upon several of the animals to describe what they see.

- Then tell the children that some people have come to chop down some trees. Have the outer circle of the rainforest sit down. Have children at the center of the forest describe their environment now and how it is changing. Have animals move around in the forest. Have them describe their environment and how it is changing.

- Tell children that more trees are going to be chopped down. Ask several "trees" in the outer circle to sit down. Ask the children who are sitting to describe how the forest has changed and how this is affecting the animals. Chop trees several more times and ask children in the center of the forest and the animals to describe their environment, how it is changing, and how it is affecting them.

- **Conclusion** Have children each draw a picture of their favorite plant or animal from the rainforest. Have write a sentence about the plant or animal or dictate a sentence for you to write at the bottom of their pictures. Display the pictures on the bulletin board.

Biological research at the American Museum of Natural History occurs both in the laboratory and in the field. This reasearch has resulted in an unrivalled collection of biological information that may help explain the origins of humans and animals.

Museum entomologists study insects, the most diverse group of organisms. Research includes the study of ancient insects preserved in amber whose DNA provides clues to rates of species change, and insect biodiversity in South America. Museum entomologists collect, catalogue, and study specimens, which number over 17 million.

Amphibians, reptiles, and fishes comprise the greater part of vertebrate biodiversity and are found in all habitats of the world. Collections of the Departments of Herpetology (the study of reptiles and amphibians) and Ichthyology (the study of fishes) permit the investigation of the evolution of these animals, and of their presently changing status on an Earth increasingly disturbed by human activity.

The Department of Mammalogy researches the origin, evolution, biology, and ecology of the world's mammals. Department of Ornithology scientists are engaged in research on the systematics and natural history of birds through fieldwork and the use of the Department's collections. The record of fossil and modern invertebrates provides a remarkable history of life on this planet. The number of invertebrates, both past and present, probably represents one half billion species, encompassing a wide diversity of forms. The goal of the Department of Invertebrates (the study of animals without backbones) is to document the systematics, evolution, extinction, and life history of this group. Similarly, Vertebrate Paleontology (the study of fossilized animals with backbones) conducts extensive field research in its quest to piece together the history of vertebrate evolution and better understand the present relationships found in the modern world.

The Museum also houses: The Center for Biodiversity, which studies world ecosystems, the complex interactions within, them and the effects of human on them; The Micropaleontology Press, which researches ancient microfauna to help understand the Earth's geological and biological past; and The Molecular Systematics Laboratory, which combines molecular information provided by DNA research, and poses questions about biodiversity, evolution and systematics.

The Museum's biological research stations include: The Southwestern Research Station, Great Gull Island, St. Catherines Island and Black Rock Forest.

All In A Day's Time

(4th through 6th Grade)

The Visible Woman Hologram in the Hall of Human Biology and Evolution beautifully illustrates the human body. The hologram, a three-dimensional model, seems to melt away, organ by organ, as you move from left to right. It allows us to see how the organs and systems of our body are positioned. One thing it cannot portray, however, is the way these systems work together. The following activity will help students understand how the systems in our bodies work together to maintain the steady state called homeostasis, the maintaining of a constant internal environment.

Objectives

Students will:

- discover how the systems of their bodies work together to maintain homeostasis;
- identify the many and varied activities they do each day.

Materials

- chart, "It's All in a Day's Time" – one copy for each student (on facing page)
- overhead projector (optional)

Procedure

- **Warm-up** Ask students to suggest a vigorous activity that they do, such as running. Point out that running is an activity that expends energy. Have students identify all the body systems used in running. Write their suggestions on the board along with the function of that system. For example: muscular system –provides motion; respiratory system –provides oxygen to muscles. Allow students time to discuss all the systems involved in running.

- Explain that running is just one of many activities we do each day. As we move from activity to activity, the body must maintain its internal operation, regardless of what kind of activity the person is involved in. The maintaining of a constant internal environment is called homeostasis. Ask students to name resting activities and activities that take in energy. Then tell students they will each record their activities over a 24–hour period to explore how their bodies maintain homeostasis.

- Distribute the chart to each student. Read the directions with them, making sure students understand what to do:

- list every activity they do for a 24–hour period;

- identify the amount of time the activity was done;

- identify all the systems involved in that activity;

- identify whether energy was taken in or expended or whether it was a resting activity.

- Lead students in a discussion of their findings. Have them identify the amount of time they spent taking in energy(eating), expending energy (exercising) and resting (sleeping, watching TV). Use the overhead projector to display one or two of the students' charts.

- **Conclusion** Help students conclude that everyday responses and activities use energy and are controlled by the interaction of many systems, such as the skeleton, nerves, muscles, body chemicals and so on. The body's response maintains homeostasis. If homeostasis did not occur, we wouldn't be able to live very long. Maintenance is a continual process.

Recording Chart

Directions: List, in order, all the activities you do during a 24-hour period. For each activity, list the duration, and the systems involved (Save the category for later).

Activity	Duration	System Used	Category (expend energy, take in energy, rest)

A Record in Time

(3rd through 6th Grade)

A cross–section slice of a tree is a record in time, revealing transitions in the life of the tree. It lists seasonal and local variations in precipitation and the environment, as well as ecological events of possible insect infestations, crowding, fires, and drought. This activity will help students explore a tree's growth from year to year.

Objectives

Students will:

- observe the growth rings of a tree
- use their observations to gain information about the tree and how it grew from year to year

Materials

- recently cut cross–section slices of a tree (one per group) Have the school maintenance department or the wood working shop cut a log into slices 1" to 2" thich. Have students sand one side smooth.

Procedure

- **Warm–up** Ask students what they can tell you about a tree by looking at it. (Responses may include: the type of tree, estimation of age, whether or not it is healthy, and so on.) Tell students that a cross–section of a tree provides clues as to how a tree lived year to year.

- Duplicate and distribute "Cross–section Slices: What the Markings Mean" (page 32) to students. Have students use the diagrams and the information to understand how the environment effects each tree's growth and how this is recorded in each tree's growth rings. Tell students that they will work in groups to examine a tree slice.

- Have students work in small groups of three to four. Provide each group with a cross–section slice of a tree. Provide A Record In Time: Observation Sheet for each student. Have students use the questions on the sheet to guide their examination of the tree slice.

- Have students label parts of the cross–section. When students have finished their observations, have them share their findings with the rest of the class.

A Record In Time: Observation Sheet

Annual rings are layers of growth which are added each year during the life of a tree. Each ring has a light and dark band made of cells. The cells in the light band grow quickly during the spring. Those in the darker band grow slowly during the summer. In years with lots of rain and sun trees grow faster and the rings will be wider than in years when there is little rain.

Leaf–eating insects and caterpillars can severely hurt a tree. If the attack results in a major loss of leaves, the tree will grow only slightly for several years, laying down tightly spaced growth rings. The tree will also grow slowly when there is competition for sunlight, water, and nutrients from the soil from neighboring trees. The rings will be unevenly spaced and narrower wherever other trees occur.

Use the tree slice to answer these questions.

1. How old is the tree? Count the growth rings. If the tree was cut down this year, in what year did the tree begin to grow?

2. During which years did the tree grow faster? During which years did the tree grow slower?

3. Are any growth rings tightly spaced together? What might have caused them to grow this way?

4. Is there any evidence that the tree competed for sunlight, water, or soil nutrients with other trees? What is your evidence?

5. Did this tree ever experience a fire? What is your evidence?

Read the definitions below. Find each part on the tree slice and label it.

cambium A thin layer of cells next to the phloem that make the trunk, branches and roots of a tree grow thicker. The cambium layer of tissue between the phloem and the xylem grows both inward and outward increasing the diameter of the tree annually.

heartwood The central wood of a tree trunk, the supportive inner core.

inner bark the phloem. Its outer cells turn to bark. It conducts food (sugar) dissolved in water, from the leaves to the rest of the tree.

outer bark The outer layer which insulate the tree from rain, extreme heat and cold and protects it against insects.

phloem same as inner bark

sapwood the xylem, the outer layer of wood whose inner cells turn to heartwood. It carries water and dissolved inorganic salts (mineral nutrients) during the growing season from the roots to the leaves.

xylem: same as sapwood

Cross-Section Slices: What The Markings Mean

When a tree is cut you can see patterns in the wood. Each "ring" represents one year's growth. These rings can also tell us about the tree's history.

Stump

If you count the rings of this tree you will find that it was 20 years old when it was cut.

Simple Rings

Fire damage and lightening often scar trees. Sometimes creating large burned areas that take years to grow over. Other times causing only slight changes in the rings.

Burned Tree Ring

This tree was shaded from the northwest which caused it to grow towards the southeast.

Shaded Tree

When all the growing conditions are good the tree rings are wider and more evenly spaced.

When tree conditions are poor the tree will lay down narrow growth bands.

Good Year / Bad Year Rings

Sense of Smell

(2nd through 6th Grade)

Many animals have acute senses of smell by which they locate prey, their offspring, or mates. They may also use this sense to identify their location. This activity allows students to simulate the process of olfactory identification.

Objectives

Students will:

- understand how animals use their sense of smell;
- locate a partner using their sense of smell.

Materials

- film canisters – one per pair of students (available from a photo store free of charge)
- cotton balls
- self–stick tags
- a variety of scented oils and liquids such as scented bath oils, food flavorings, and so on.
- two plastic containers (large margarine containers)

Advanced Preparation

- Open the canisters. Place a drop of glue on the inside of the lid and on the inside bottom of the canister. Glue a cotton ball to each and let dry. Saturate the cotton on the top and bottom with a scent of the same kind. Seal the canister, place a self–stick tag to the bottom and the top, mark the top with the letter A, the bottom with a Z. Continue until all the canisters are scented with a different odor and coded B+Y, C+X, etc..

Procedure

- Ask students to describe how they use their sense of smell and what it can tell them about the world around them. Ask students to describe how animals use their sense of smell. If students do not mention it themselves, point out that animals use their sense of smell to find food – prey or plants, to locate their offspring, to find their mates, or to identify their location. Tell students that today they are going to experiment with their sense of smell.
- Open the canisters and put the lids in one container and the bottoms in another. Divide the class into two equal groups. Designate one group as parents and the other offspring. Have each "parent" choose a canister bottom. Have each "offspring" choose a canister lid. Have parents stand at one end of the room and offspring at the other.
- Tell students you want them to use their sense of smell to pair parent with offspring. Instruct students to find their parent offspring by locating the student that has the identical smell as their own. Once the class is paired have them check their accuracy by matching the letters using the code.
- Allow students time to discuss the activity and to describe what they learned about their sense of smell.
- *Alternate Activity* This activity can be modified to explore the sense of hearing. You will need one canister for every student and a variety of small items such as pennies, paper clips, screws, etc. (two of each). Take two screws, place each one in a separate canister and replace the top. Continue in this manner until you have a canister for each student. Place the canisters in a bag or box and ask each student to choose one. Then instruct students to find their partner by listening carefully to the sound that is made when their own canister is shaken and locating the canister that makes that identical sound.

Anthropology

examines the origin, development and current state of the human species in all its diversity. The field of anthropology is therefore quite broad, for anthropologists illuminate many aspects of the human condition. The subfields of anthropology represented by the research of Museum curators include cultural anthropology, archaeology, and physical anthropology.

The research interests of the curators are quite diverse. They reflect different theoretical approaches as well as cover a wide geographical range. Their work includes research on primate evolution and the origin of the species Homo sapiens; archaeological research on Andean civilizations; the excavation of early Creek Indian sites in Georgia; research on the early Zapotec state in Mexico and early chiefdoms in the grasslands near the Venezuelan Andes; research on the evolution of chiefdoms and studies of contemporary Amazonian peoples; the analysis of early collecting practices in the Congo, women and children in Nigeria and research on Ghana; the examination of shamanism, contemporary marriage practices and social change in Korea; and the analysis of historical data from North India.

The curators are responsible for coordinating research projects and for the collection and display of objects. Today the anthropology collection consists of approximately eight million artifacts, of which only a fraction are on display. The Museum's collection of ethnographic materials, such as myths and other texts, is considered to be one of the most important of its kind in the world.

Anthropology's history at the Museum dates to the late 19th century when Franz Boas, "the Father of American Anthropology", spearheaded collecting expeditions. He believed that all cultures deserved respect and sponsored expeditions to areas where the cultures were in danger of dying out. The first permanent exhibit of anthropological objects was the Hall of Northwest Coast Indians which opened in 1910.

The Anthropology department also includes a large collection management and conservation staff that works to maintain and preserve the objects. Recently work has begun to install state of the art storage facilities and to create a digital imaging database as well as computerized catalogs. A summary of the Museum's collections from North America are being compiled for use by Native American organizations and tribes.

Oware

(2nd through 6th Grade)

In Ghana, it is called Oware and it is one of the world's oldest and most popular games. It is played in many African countries and throughout the world. Legend has it that Cleopatra played it in Egypt. Rules vary enormously, from country to country and even from village to village. But the basic structure of the game is the same as when the pyramids were built 4500 years ago.

Objectives

Students will:

- learn an African counting game;
- practice problem–solving skills.

Materials

- an empty egg carton for each pair of players
- 48 dried beans (24 per player)

Procedure

- Ask students to name some of the board games they have played and to briefly describe the objective of the game. Tell students that one of the world's oldest games is Oware, which originated in Africa about 4500 years ago. Explain that they will try their own skills at Oware. Point out that the object of the game is to capture the other player's beans.

- Have players sit opposite each other with the egg carton in front of them on the table. The six cups facing each player is that player's "village." Each player puts four beans in each cup. To begin the game, Player A picks up four beans from any of his six cups. Going counter clockwise he drops one bean into each of the cups that follow the cup from which he picked up the beans. Player A picks up all the beans from the cup into which he dropped the last of the four seeds. He continues playing until he drops the last seed in his hand into an empty cup.

- Player B continues the game by picking up all the beans in any cup on his own side of the board, and starting with the next cup, drops one bean in each cup, moving counterclockwise. The game continues with players A and B taking turns.

- The aim of each player is to build up an empty hole back to its original set of four beans, and to win the sets. A player captures beans when the last bean dropped into a cup brings the total of that cup to four beans. Beans can be captured from one's own side of the board or from an opponent's side. Captured beans are placed on the side.

- The player to win all the beans or the most beans at the end of the length of play agreed upon wins.

- Talk with students about the strategies they employed to win. If time allows, have students play again using the strategies they learned.

Masks

(2nd through 6th Grade)

African Mask

Photo: ANMH

The dramatic art of African masks brings the worlds of nature and the supernatural into the known and more predictable community of humans. Many African belief systems require men (very rarely women) to bring forth spirits by impersonating them so that these spirits may act upon the human realm and, equally, so that people may respond to — thank, placate, entertain — the forces upon which life depends. In traditional African cultures, spirit transformations are complex phenomena. Artistic expression in Africa is a way of life. The mask, which represents an authoritative figure, comes to life when adorning a mere mortal. Masks as well as drums are essential to African dance. The drummer signals the ancestral spirit when to start, change or stop the movements. The dancer wears clothes patterned with the family, tribal, and societal markings. The songs, chants, and praise empowers the masquerade or dancers in their celebration of life.

Objectives

Students will:

- examine how other cultures use masks to reflect life;
- create masks that reflect their own cultural experiences.

Materials

- balloons
- newspaper cut in strips
- flour and water paste or glue for papier mache
- magic markers, paints, sequins, feathers, leaves, beads, buttons, and other findings

Procedure

- Discuss with students the significance of clothing and costuming in different cultures. Ask students how meaning is conveyed by what is worn. Talk about the various clothing and masks the students saw at the Museum. Ask students to describe some of the masks they saw and what the students thought was significant about the masks. Lead students in a discussion about how the masks reflect the life of the people who wear them.
- After exploring their own history and examining how different cultures use masks to reflect life, students can create their own masquerade reflecting their own cultural experiences. Students may use the directions on the next page to create papier mache masks or they may cut masks out of cardboard and decorate them with magic marker, feathers, beads, buttons or other findings.

Making Masks

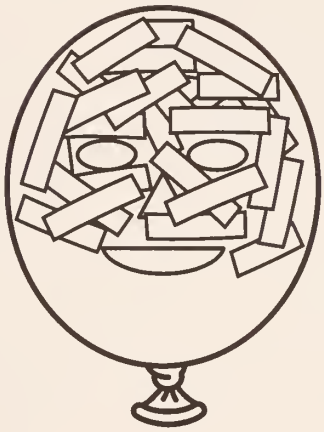
Directions for making masks:

1.

Blow up a balloon. With a magic marker draw two ovals for eyes. Mark an area for the nose and mouth.

2.

Spread glue or paste thinly on one strip of newspaper. Place the strip over the balloon avoiding the eye and mouth area. Use your finger to smooth out any bubbles or wrinkles.



3.

Continue until you have one layer of paper mache covering one half (the face) of the balloon. Allow the paper mache to dry overnight.

4.

Form the nose by using a wad of newspaper covered with strips of paper mache. Continue with two more layers of paper mache, allowing drying time in between each layer.

5.

When the mask is dry, carefully pop the balloon and remove the rubber. Use paint or magic marker to decorate the balloon. You may also glue on beads, buttons, feathers or other items.

6.

Present your mask to the class. Explain the meaning of the mask and how it reflects your cultural experiences.

Cloth Design

(3rd through 6th Grade)

Photo: Dr. Enid Schildkrout

Clothing with Andinkra design

Throughout the world people have used varying techniques to decorate cloth. Some designs are woven into the cloth as it is being loomed. Other designs are added later once the cloth is woven. In some cultures designs are stenciled onto the cloth. In others, designs are painted on the cloth with wax. The cloth is then dyed and the wax finally removed. Stamping is also used to decorate cloth. The Asante of Ghana, West Africa use stamps called "adinkra" to decorate their cloth with traditional symbols that have historical or magical significance. Adinkra are carved from the tough outer shell of a calabash, a pumpkin-like gourd. Small sticks attached to each corner of the stamp and brought together at the top make a convenient handle. Dye for the stamping is made from the boiled bark of a local tree.

Objectives

Students will:

- learn techniques of African adinkra printing;
- create a cloth with traditional adinkra symbols.

Materials

- wooden blocks (3 inches square)
- rubber from a tire–patch kit
- white cloth or paper for the printing
- stamp pad
- scissors

Procedure

- Call upon students to discuss the various methods of decorating cloth that they know of. If students have difficulty, you might mention batik, stencil design, woven designs and stamping. Display the adinkra designs. Point out to students that these adinkra symbols each had historical or magical significance and represented proverbs, state or sacred symbols, or actual objects. Tell students that today they are going to make their own adinkra cloth design.

- When students have completed their designs allow them time to present their finished work to the class. Display the designs on the bulletin board, in the school library, or in a school corridor display case.

How To Create An Adinkra Cloth Design

Materials

- wooden blocks (3 inches square)
- rubber from a tire–patch kit
- white cloth or paper for the printing
- stamp pad

Procedure

1. Work with a group. Decide which Adinkra design each of you will make. Using a ball–point pen, trace your adinkra design onto a two–inch square of tire patch.

2. Cut out the design and center it on the bottom of a wooden block. Use a ball point pen to mark the outline of the design on the block. Carefully pull off the plastic backing and use the markings to line up the design on the block. Press into place. You do not need glue, it should stick by itself.

3. Press the rubber design firmly on the stamp pad to coat it with ink. Then press it on the paper or fabric to be decorated. Make one or two trial stamps on scrap paper first to be sure the design is properly inked.

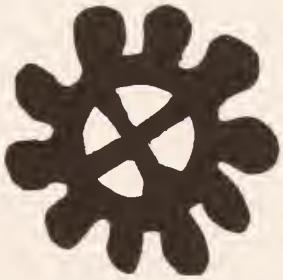
4. Trade stamps with other members of your group if you wish.

5. When you have completed your cloth, present it to your group. Describe the symbols you used and what your cloth represents to you.

Symbol of Hope

Jealousy

"Turn back and fetch it."



This symbol means "in the king's little eyes," that is, in his favor.

This design refers to the adinkra king who is cheif

Something to remove "evil" design

"I have heard what you have said."

Rangoli: The Art of Indian Floor Painting

(4th through 6th Grade)

Rangoli is an ancient Indian floor–painting tradition. Using rice paste, wheat flour, indigo, lentils, tumeric and other natural dyes, Indian women transform the barest and simplest floor surfaces, usually entrance ways, into art. To begin a woman will place the materials in small containers with wide brims. Then she will choose a newly swept place on the floor or doorstep. Next she will begin making the designs which, in most cases, are the artist's spontaneous creation. A pinch of powder is held between the forefinger and the thumb. To make the desired line, the thumb slides over the forefinger releasing a thin stream of powder. At the end of the day, the design is swept away using a grass broom.

Objectives

Students will:

- learn techniques of Rangoli, Indian floor painting;
- create a Rangoli floor painting.

Materials

- **Note:** tumeric, indigo and other natural dyes are NOT recommended for classroom use.
- corn flour, rye flour (white flour does not work well) or varied colored chalk
- colored construction paper
- small plastic cups

Procedure

- Discuss with students various ways people decorate their homes, paying particular attention to the way people decorate their floors. Write students responses on the chalkboard. Tell students that in India, women often decorate the floors, usually the entrance ways, using rice flour, seeds, tumeric and other natural dyes. Explain that this ancient art, which is called Rangoli in some parts of India and *alpona, mugu* and *kolam* in others, is practiced solely by women. The designs are created on newly swept floors in the morning and swept away in the evening. Display pictures of Rangoli art to students and allow them to respond to them. Tell them that they will have an opportunity to learn and practice the art of Rangoli.

- Have students work in pairs. Provide each pair with a small cup of corn flour, a small cup of rye flour, and two sheets of construction paper. Tell students they may create a design as they go, which is traditional, or they may sketch a design on the construction paper first. Suggest students begin by creating simple lines, squares and curves. Lead students in creating designs using the following instructions:

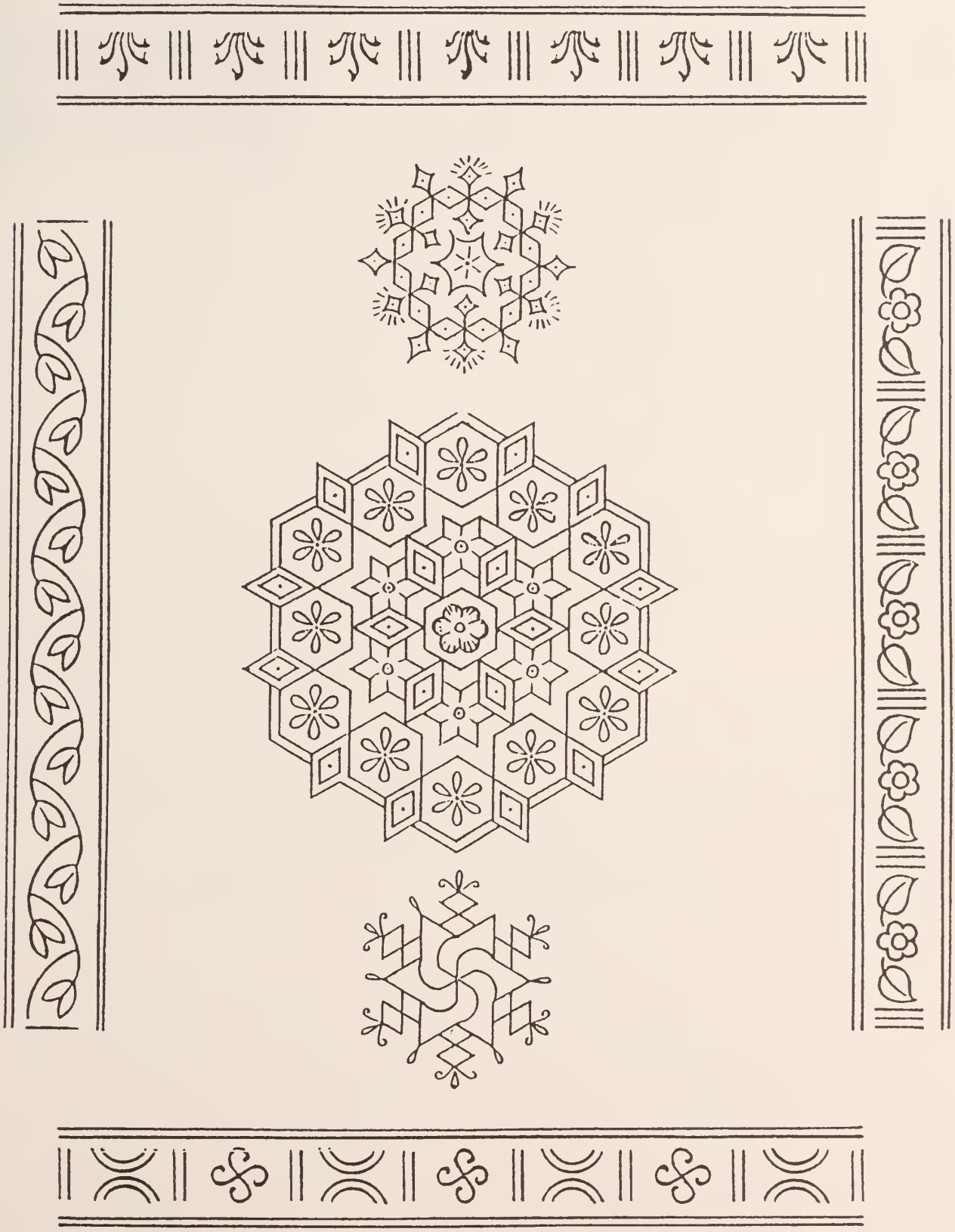
  Take a pinch of flour between your forefinger and thumb, shake off the excess. Move your hand to the place where you will begin. Slide your thumb slowly over the forefinger, carefully dropping off powder. Move your hand over the surface in a straight line so that the falling flour forms a line. Continue in this manner until the design is complete.

- Have students practice making straight and curved lines, as well as flowers and other symbols using this technique.

- Have students make designs on the construction paper. Then give them time to walk around the classroom to look at the work their classmates have done.

- This activity may be extended by having students create a Rangoli design on the school sidewalks or playground. Colored chalk may be substituted for the traditional Indian materials.

Rangoli Designs



The African Drum

(3rd through 6th Grade)

African Drum

Photo: AMNH

The drum is the principal and most popular instrument in traditional African cultures. Drums are used to warn of approaching danger, praise chiefs, recount the history of the town or village, report the news of the day, and send messages over long distances. Most importantly they are used in sacred ceremonies. Drums are carved from wood and may be decorated with paint or designs that express the drum maker or drummer's ideas. The drum head, or top is usually made of animal skin, such as the skin of a goat, cow, antelope, lizard, or snake. Some societies have strict rules that govern the drummer, how the drum is made, and how the drum is handled.

Objectives

Students will:

- examine the importance of the drum in traditional African cultures;
- make and use a drum.

Materials

- a recording of African drum music (see discography, page 44)
- an empty 10–pound can (usually available from the school cafeteria or a restaurant)
- cotton cloth, 1 foot square
- cloth strip, 1 inch wide by 36 inches long
- small bottle of white glue (Elmer's)– 2 to 4 oz.
- paint brush, 1 inch wide
- scissors
- bowl large enough to mix the glue with the water

Procedure

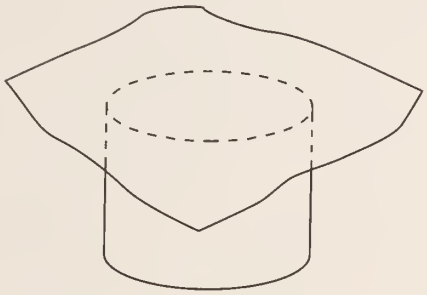
- Play African drum music for students and have them note the rich tones and rhythms. Explain that the drum plays an important role in traditional African cultures. Drums are used to warn of approaching danger, praise chiefs, recount the history of the town or village, report the news of the day and send messages over long distances. Most importantly they are used in sacred ceremonies. Ask students to recount their own experiences with drums and drum music.

- Using the directions on the next page, have students make drums of their own. Encourage students to try their hand at African drumming or to create drum rhythms of their own.

How To Make A Drum

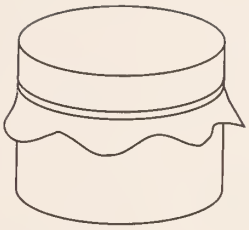
Materials

- an empty 10–pound can (usually available from the school cafeteria or a restaurant)
- cotton cloth, 1–foot square
- cloth strip, 1 inch wide by 36 inches long
- small bottle of white glue (Elmer's)– 2 to 4 oz.
- paint brush, 1 inch wide
- scissors
- bowl large enough to mix the glue with the water
- magic markers, poster paint, paint brushes



1.

Remove both lids from the can. Place the can on a table. Cover the top of the can with the 1–foot square cloth and smooth out any wrinkles.

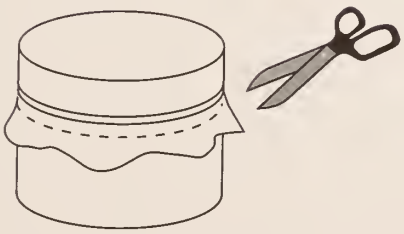


2.

Use the strip of cloth to tie the square cloth in place. Wrap the cloth strip around the cloth and knot it tightly. Smooth out any wrinkles.

3.

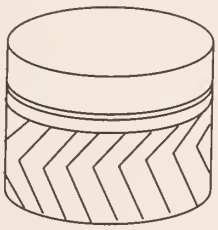
Place the glue in the bowl and add twice as much water (If you use 2 ounces of glue, use 4 ounces of water.). Mix well. Paint the glue mixture onto the drum's cloth surface — the top, sides, and cloth strip. Make sure the entire cloth is painted.



4.

Pull the sides of the drumhead cloth down so that there are no wrinkles on the top or sides. Make sure the top of the drum is tight. A tight drumhead will make a better sound.

Cut off any extra cloth, leaving about 2 inches beneath the wrap cloth. Allow several hours for the glue to dry.



5.

Decorate the drum with African symbols or with symbols of your own.

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- *African Rhythms and Instruments*
- *Drums of the Yoruba of Nigeria*
- *Master Drummer from Ghana*

These and other records and cassettes are available at the Lincoln Center Performing Arts Library (212) 870-1630

- *Flute Songs of the Kiowa and Comanche*
- *Honor the Earth Pow Wow*
- *Sounds of Indian America: Plains and Southwest*

These and other records and cassettes are available at the American Museum of Natural History Store.

- *Traditional and World Music*

Records and cassettes are available at Lyrichord Discs, Inc., 141 Perry Street, New York, 10014, (212) 929-8234.

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Education Department

Project Director
Ismael Calderon, Assistant Chairman
Science and Multicultural Outreach Programs

Supervising Editor and Writer
Christine Economos

Design
Pentagram

Contributors
Bradford Burnham, Senior Lecturer

Margaret Cooper, Editor, Exhibition Department

Stephanie Fins, Dalton School Lecturer

Uta Gore, Senior Lecturer

Jay Holmes, Coordinator of After School Programs

James McKenna, Science Educator, Museum School

Emily Ogrinz, Senior Lecturer

Stephanie Penceal, Manager of Multicultural Programs

William Schiller, Senior Lecturer

Monica Volkmann, Coordinator of Precollege Science Collaborative Program

Teddy Yoshikami, Coordinator of Multicultural Programs

Proofreader
Kevin E. Kennedy

Administrative Assistant
Karen Lund

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Lowell Dingus, Ph.D., Project Director, Fossil Halls

Niles Eldredge, Ph.D., Curator, Invertebrates

Enid Schildkrout, Ph.D., Curator, Anthropology

The Department of Library Sciences, AMNH

Photo Studio, AMNH

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